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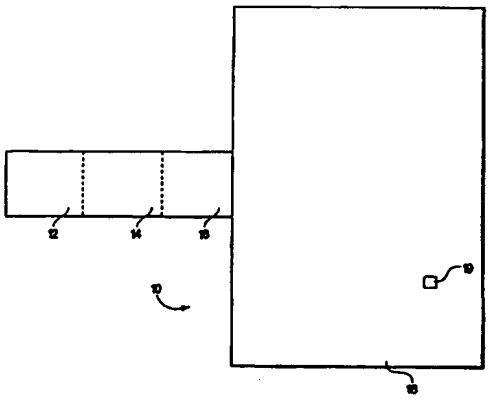

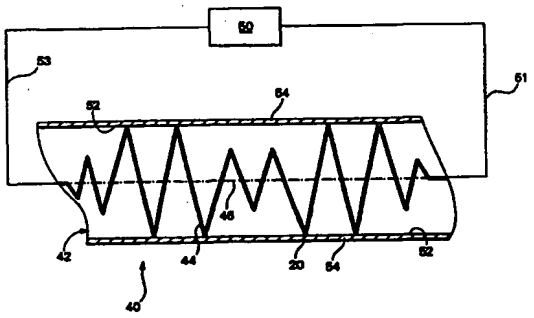

(57) Abstract

An apparatus and method for guiding, protecting and providing bend radius control for fiber optic cables is provided. Channel members having slots are used to connect fiber optic cable termination enclosures and raceway systems. In accordance with the invention, a fiber optic cable bend radius control device is snapped into each slot in the channel member. Projections on the fiber optic cable bend radius control device retain the device to the edges of the slot. The fiber optic cable bend radius control device has a gradually curved surface. Fiber optic cables extending from the enclosure to the raceway system through the slot rest on the curved surface on the fiber optic cable bend radius control device. The curved surface of the fiber optic cable bend radius control device provides a smooth, continuous surface for guiding, protecting and controlling the bend radius of fiber optic cables as they pass through the slot.

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FIBER OPTIC CABLE BEND RADIUS CONTROLLER

Technical Field

This invention relates to fiber optic cable bend radius control and, more specifically, an apparatus and method for controlling the bend radius of fiber optic cables.

Background Of The Invention

Optical fiber communication systems are extensively used in the telecommunications industry. Communication systems employing optical fibers have termination points where optical fiber cross connections, interconnections and terminations are performed. The termination points are generally located at a customer's premises, remote from a central office.

At each termination point, optical fibers must be separated from outer protective cable components for splicing and termination. Several different types of enclosures or equipment racks for use at the termination points are available to protect optical fibers and fiber optic cables. These include, for example, the enclosures or equipment racks described in the United States Patent No. 5,353,367 to Czosnowski et al. dated October 4, 1994, United States Patent No. 5,119,459 to Meyerhoefer et al. dated June 2, 1992, United States Patent No. 5,241,617 to Peacock et al. dated August 31, 1993, United States Patent No. 5,067,784 to Debortoli et al dated November 26, 1991, United States Patent No. 4,717,231 to Dewez et al. dated January 5, 1988 and United States Patent No. 5,287,428 to Shibata dated February 15, 1994.

Fiber optic cables are routed from the enclosure or equipment rack through a building using various types of supports. For example, fiber optic cable raceway systems comprised of U-shaped channel members of various shapes and sizes are available to permit such routing.

Straight walled and curved U-shaped channel members may be used to provide support and bend radius control for fiber optic cables as shown in United States Patent Application No. 08/425,798, now abandoned, United States Patent Application No. 08/768,127, United States Patent No. 5,335,349 to Kutsch et al. dated August 2, 1994, United States Patent No. 5,394,502 to Caron dated February 28, 1995 and United States Patent No. 5,469,893 to Caveney et al dated November 28, 1996.

Abutting one side of the enclosure or equipment rack is a U-shaped channel member having slots. The slots in the slotted channel member line up with openings in the enclosure or equipment rack. The slotted channel member is connected to the fiber optic cable raceway system. Thus, fiber optic cables can be routed from the enclosure or equipment rack through the openings, slots and slotted channel member to the fiber optic cable raceway system as shown, for example, in United States Patent No. 5,287,428 to Shibata dated February 15, 1994.

The slotted channel members have thin walls. The slots are cut in the thin walls of the slotted channel members and thus have thin, sharp edges. Fiber optic cables passing from the enclosure or equipment rack to the fiber optic cable raceway system through the slots in the slotted channel member rest on the thin, sharp edges of the slots. Resting the fiber optic cables on the thin, sharp edges of the slots may pull, bend, break or otherwise damage the fiber optic cables or may cause a loss of performance.

Thus, there is a need in the art for an inexpensive and easy to use apparatus and method to guide, protect and control the bend radius of fiber optic cables as they pass from an enclosure or equipment rack to a fiber optic cable raceway system through slots in a slotted channel member.

Summary Of The Invention

The invention is an apparatus for guiding, protecting and providing bend radius control for fiber optic cables and a method of using the same. More specifically, in accordance with the invention, fiber optic cable bend radius control devices are snapped into slots in the slotted channel member. Projections on the fiber optic cable bend radius control devices secure the devices to the thin, sharp edges of the slots.

Each fiber optic cable bend radius control device has a gradually curved surface facing inwardly into the slots. Fiber optic cables extending from the enclosure or equipment rack to the fiber optic cable raceway system through the slots rest on the curved surfaces of the fiber optic cable bend radius control devices. The curved surfaces of the fiber optic cable bend radius control devices provide smooth, continuous surfaces for guiding, protecting and controlling the bend radius of fiber optic cables as they pass through the slots.

Brief Description Of The Drawings

Figure 1 is a perspective view of an embodiment of the fiber optic cable bend radius control device in accordance with the invention.

Figure 2 is a cross-sectional view of an embodiment of the fiber optic cable bend radius control device in accordance with the invention.

Figure 3 is a side view of an embodiment of the fiber optic cable bend radius control device in accordance with the invention.

Figure 4 is a perspective view of an alternative embodiment of the fiber optic cable bend radius control device in accordance with the invention.

Figure 5 is a side view of an alternative embodiment of the fiber optic cable bend radius control

device in accordance with the invention.

Figure 6 is a perspective view of an alternative embodiment of the fiber optic cable bend radius control device in accordance with the invention.

Figure 7 is a side view of an alternative embodiment of the fiber optic cable bend radius control device in accordance with the invention.

Figure 8 is a top view of an alternative embodiment of the fiber optic cable bend radius control device in accordance with the invention.

Figure 9 is a bottom view of an alternative embodiment of the fiber optic cable bend radius control device in accordance with the invention.

Figure 10 is a front view of an alternative embodiment of the fiber optic cable bend radius control device in accordance with the invention.

Description Of Preferred Embodiments

Referring to Figure 1, there is shown an embodiment of the fiber optic cable bend radius control device 20 in accordance with the invention in the environment of its intended use. Channel member 2 has a base 4 and two side walls 6 and 8. The base 4 and side walls 6 and 8 are arranged so that the channel member 2 is U-shaped in cross-section. Side walls 6 and 8 each have two ends. One end of side wall 6 and one end of side wall 8 are attached to base 4. The opposite ends of side walls 6 and 8 are free.

Side walls 6 and 8 have slots 10. The slots 10 extend from the free end of side walls 6 and 8 toward the ends of side walls 6 and 8 that are attached to base 4.

Slots 10 have wide portions 14 and narrow portions 16. The wide portions of slots 10 are approximately centered on the side walls 6 and 8 between the ends of the side walls attached to the base 4 and the free ends. Wide portions 14 of slots 10 have edges 14a,

14b, 14c and 14d. The narrow portions 16 of slots 10 extend from the free ends of side walls 6 and 8 to the edges 14d of wide portions 14 of slots 10.

Side walls 6 and 8 have retainers 12 at the free ends of the side walls. Retainers 12 are designed to secure a cover (not shown) to channel member 2. The narrow portions 16 of slots 10 are located in between retainers 12 on the free ends of side walls 6 and 8.

Referring to Figures 1-3, there is shown an embodiment of a fiber optic cable bend radius control device 20 in accordance with the invention. Figure 2 shows a vertical cross-sectional of the fiber optic cable bend radius control device 20 in the environment of its intended use. Figure 3 is side view of the fiber optic cable bend radius control device 20.

The fiber optic cable bend radius control device 20 attaches to the wide portion 14 of slot 10 of channel member 2. The embodiment of the fiber optic cable bend radius control device 20 shown in Figures 1-3, which comprises two parts 20a and 20b, specifically attaches to the opposite edges 14a and 14c of wide portion 14 of slot 10 in channel member 2.

When viewed in cross-section as shown in Figures 2 and from the side as shown in Figure 3, each part 20a and 20b of the fiber optic cable bend radius control device 20 is comprised of a continuous sheet of material formed to have a gradually curved surface 22, horizontal portions 24 and 26 and closely spaced vertical portions 28 and 30. The fiber optic cable bend radius control device 20 is snapped onto opposite edges 14a and 14c of wide portion 14 of slot 10 in channel member 2. Vertical portions 28 and 30 fractionally engage and thereby secure the fiber optic cable bend radius control device 20 to the opposite edges 14a and 14c of wide portion 14 of slot 10 as shown in Figures 1 and 2.

Once the fiber optic cable bend radius control

device 20 is secured to the opposite edges 14a and 14c of wide portion 14 of slot 10, fiber optic cable 32 in channel member 2 is placed in the narrow portion 16 of slot 10 and is pushed toward the wide portion 14 of slot 10 until the fiber optic cable 32 is in the wide portion 14 of slot 10. Once the fiber optic cable 32 is in the wide portion 14 of slot 10, the fiber optic cable can rest on the curved surface 22 of the fiber optic cable bend radius control device 20. Curved surface 22 provides a smooth and continuous surface to guide, protect and control the bend radius of fiber optic cables 32 extending from channel member 2 through slots 10 into enclosure 34.

Referring to Figures 4-10, there is shown another embodiment of a fiber optic cable bend radius control device 20 in accordance with the invention. Figure 4 is a perspective view of the fiber optical cable bend radius control device 20 in the environment of its intended use. Figure 5 is a side view of the fiber optic cable bend radius control device 20 in the environment of its intended use. Figure 6 is a perspective view of the fiber optic cable bend radius control device 20. Figure 7 is a side view of the fiber optic cable bend radius control device 20. Figure 8 is a top view of the fiber optic cable bend radius control device 20. Figure 9 is a bottom view of the fiber optic cable bend radius control device 20. Figure 10 is a front view of the fiber optic cable bend radius control device 20 shown in a deflected position.

The fiber optic cable bend radius control device 20 attaches to the wide portion 14 of slot 10 of channel member 2. The embodiment of the fiber optic cable bend radius control device 20 shown in Figures 4-10 specifically attaches to the edges 14a, 14b and 14c of wide portion 14 of slot 10 in side wall 6 of channel member 2.

The fiber optic cable bend radius control device

20 is a U-shaped one piece trumpet design. The fiber optic cable bend radius control device 20 has projections 42, 44, 46 and 48 that cooperate to secure the device 20 in the wide portion 14 of slot 10. The fiber optic cable bend radius control device 20 is snapped into the wide portion 14 of slots 10 in channel member 2. Projections 42, 46 and 48 deflect as the fiber optic cable bend radius control device 20 is forced into the slot 10 and rebound when the device 20 is properly positioned in the wide portion 14 of the slot 10. Projection 44 serves as a backstop for the fiber optic cable bend radius control device 20 once fully inserted. In that manner, projections 42, 44, 46 and 48 secure the fiber optic cable bend radius control device 20 to the edges 14a, 14b and 14c of wide portion 14 of slot 10 of side wall 6 of channel member 2 as shown in Figures 4 and 5.

The fiber optic cable bend radius control device 20 has a base 50 and two sides 52 and 54 generally comprising the U-shaped device 20 and a portion 38 extending away from projections 42, 44, 46 and 48. As shown in Figure 10, the sides 52 and 54 may be deflected, temporarily deforming the fiber optic cable bend radius control device 20 from its U-shaped cross-section to facilitate the attachment of the device 20 to edges 14a, 14b and 14c of wide portion 14 of slot 10. The flexure, shown at 56 in Figure 10, is preferably up to two degrees with respect to each side 52 and 54 of the fiber optic cable bend radius control device 20. The portion 38 of the fiber optic cable bend radius control device 20 extending away from projections 42, 44, 46 and 48 flares outwardly in a continuous gradually curved surface 40.

Once the fiber optic cable bend radius control device 20 is secured to the edges 14a, 14b and 14c of wide portion 14 of slot 10, fiber optic cable in slotted channel member 2 is placed in the narrow portion 16 of slot 10 and is pushed toward the wide portion 14 of slot

10 until the fiber optic cable is in the wide portion 14 of slot 10. Once the fiber optic cable is in the wide portion 14 of slot 10, the fiber optic cable can rest on the curved surface 40 of the fiber optic cable bend radius control device 20. Curved surface 40 provides a smooth and continuous surface to guide, protect and control the bend radius of fiber optic cables extending from channel member 2 through slots 10 into an enclosure.

To guide, protect and control the bend radius of optical fibers, the fiber optic cable bend radius control device in accordance with the invention must provide adequate support to and prevent uncontrolled bending or tension of the fiber optic cables. Constructing the fiber optic cable bend radius control device of suitable materials would be apparent to persons skilled in the art. The fiber optic cable bend radius control device in accordance with the invention is preferably formed of a flame resistant high impact thermoplastic material. Such a material is rigid but provides for some flexure during insertion of the fiber optic cable bend radius control device into the wide portion of the slot. With respect to the embodiment of the fiber optic cable bend radius control device 20 shown in Figures 1-3, flexure of the device 20 enables frictional engagement of the vertical projections 28 and 30 with the opposite edges 14a and 14b of the wide portion 14 of the slot 10. With respect to the embodiment of the fiber optic cable bend radius control device 20 shown in Figures 4-10, flexure of the device 20 enables deflection and rebound of the projections 42, 46 and 48 and deflection of sides 52 and 54 to enable securing of the device 20 to the edges 14a, 14b and 14c of the wide portion 14 of the slot 10. Other materials for construction of the fiber optic cable bend radius control device adequate to guide, protect, support and provide bend radius control would be apparent to persons skilled in the art.

The fiber optic cable bend radius control device in accordance with the invention is made of suitable dimensions to fulfill its intended purpose. For example, the embodiment of the fiber optic cable bend radius control device 20 shown in Figures 4-10 may be constructed having a height of 2.79 inches, a width of 1.83 inches and a depth of .98 inches. Other dimensions for the fiber optic cable bend radius control device adequate to guide, protect, support and provide bend radius control for fiber optic cables would be apparent to persons skilled in the art.

It will appreciated by persons skilled in the art that herein described is a fiber optic cable bend radius control device and method of use. While the present invention has been described by reference to various preferred embodiments, it will be understood by persons skilled in the art that many modifications and variations may be made in those preferred embodiments without departing from the spirit and scope of the present invention. Accordingly, it is intended that the invention not be limited to the disclosed preferred embodiments and that it have the full scope permitted by the following claims.

I claim:

1. A fiber optic cable bend radius control device for attachment to a channel member having slots, the channel member serving as a conduit for fiber optic cables, the fiber optic cable bend radius control device comprising:

a U-shaped member having a base and sides;

projections extending from the U-shaped member for securing the device to edges of the slots;

wherein the U-shaped member flares outwardly in a gradually curved surface in a direction away from the projections.

2. The fiber optic cable bend radius control device of claim 1 wherein the U-shaped member is a one-piece continuous member.

3. The fiber optic cable bend radius control device of claim 2 wherein the U-shaped member has a projection extending from the base and a projection extending from each of the sides.

4. The fiber optic cable bend radius control device of claim 3 wherein the projections deflect to enable securing of the device.

5. The fiber optic cable bend radius control device of claim 4 wherein the U-shaped member has a projection acting as a backstop.

6. The fiber optic cable bend radius control device of claim 2 wherein the sides of the U-shaped member deflect to facilitate securing of the device.

7. The fiber optic cable bend radius control device of claim 1 wherein the device is made of a high impact thermoplastic material.

8. A fiber optic cable bend radius control device for attachment to a channel member having slots, the channel member serving as a conduit for fiber optic

cables, the fiber optic cable bend radius control device comprising:

a gradually curved surface for controlling the bend radius of optical fibers;

closely spaced portions for frictionally engaging edges of the slots in the channel member;

wherein the gradually curved surface and closely spaced portion are formed from a continuous sheet of material.

9. The fiber optic cable bend radius control device of claim 8 wherein the device is made of a high impact thermoplastic material.

10. A method of protecting and providing bend radius control for fiber optic cables comprising:

attaching a fiber optic cable bend radius control device to slot in a channel member, said fiber optic cable bend radius control device comprising a U-shaped member having a base and sides, projections extending from the U-shaped member for securing the device to edges of the slots, wherein the U-shaped member flares outwardly in a gradually curved surface in a direction away from the projections;

pushing a fiber optic cable into the slot in the channel member; and

resting the fiber optic cable on the fiber optic cable bend radius control device.

11. A method of protecting and providing bend radius control for fiber optic cables comprising:

attaching a fiber optic cable bend radius control device to slot in a channel member, said fiber optic cable bend radius control device comprising a gradually curved surface for controlling the bend radius of

optical fibers, closely spaced portions for frictionally engaging edges of the slots in the channel member, wherein the gradually curved surface and closely spaced portion are formed from a continuous sheet of material;

pushing a fiber optic cable into the slot in the channel member; and

resting the fiber optic cable on the fiber optic cable bend radius control device.

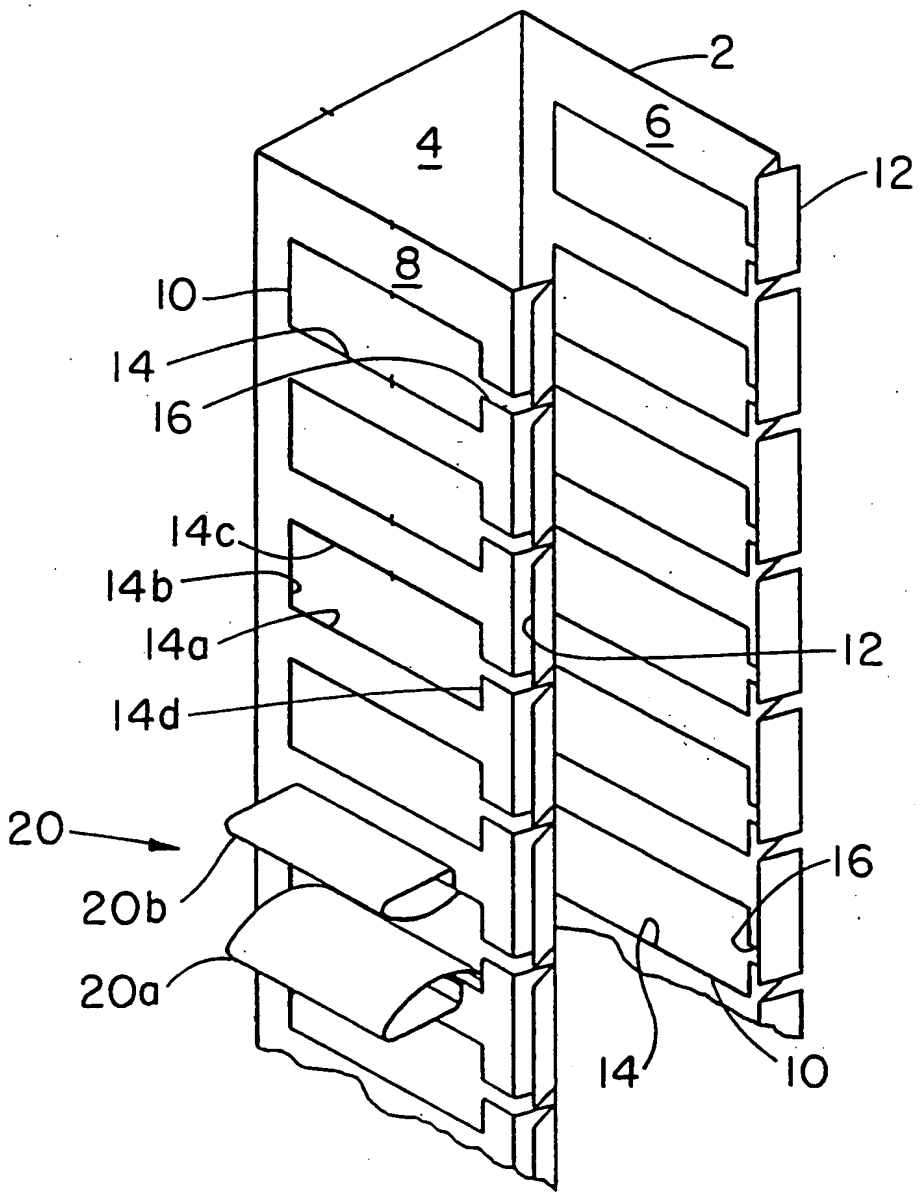

FIG. 1

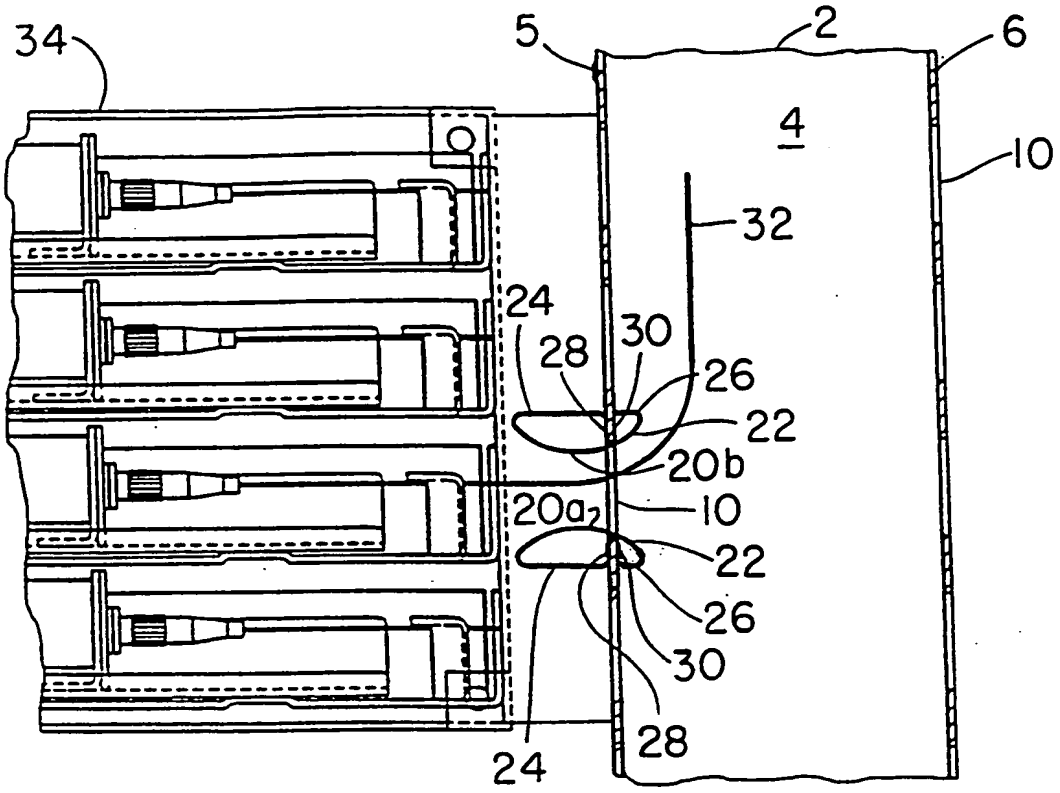

FIG. 2

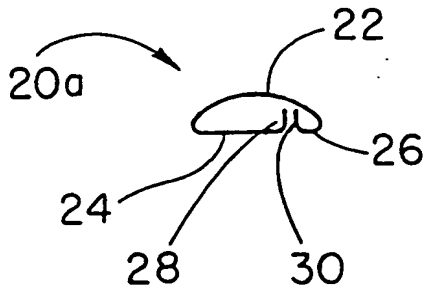

FIG. 3

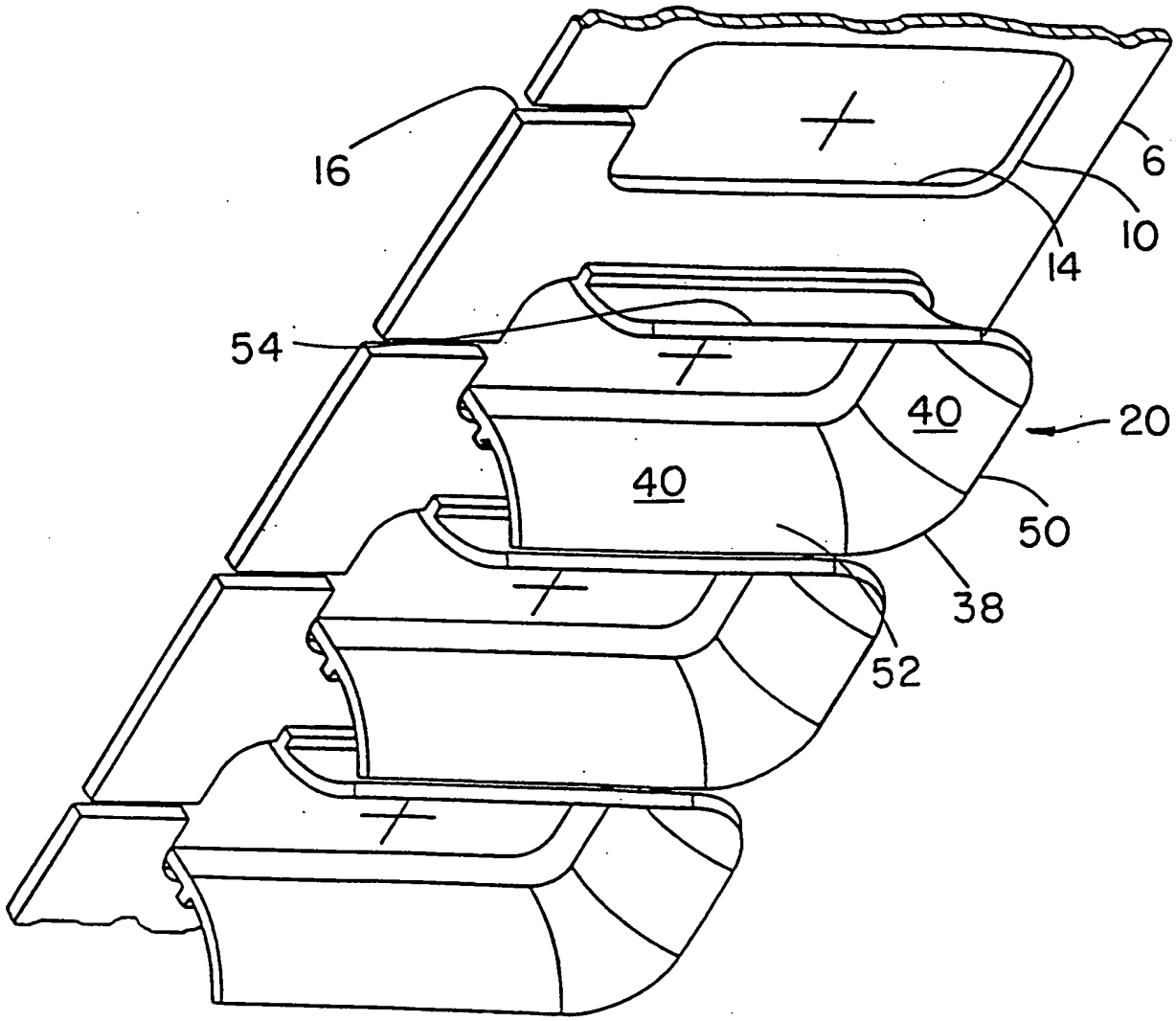

FIG. 4

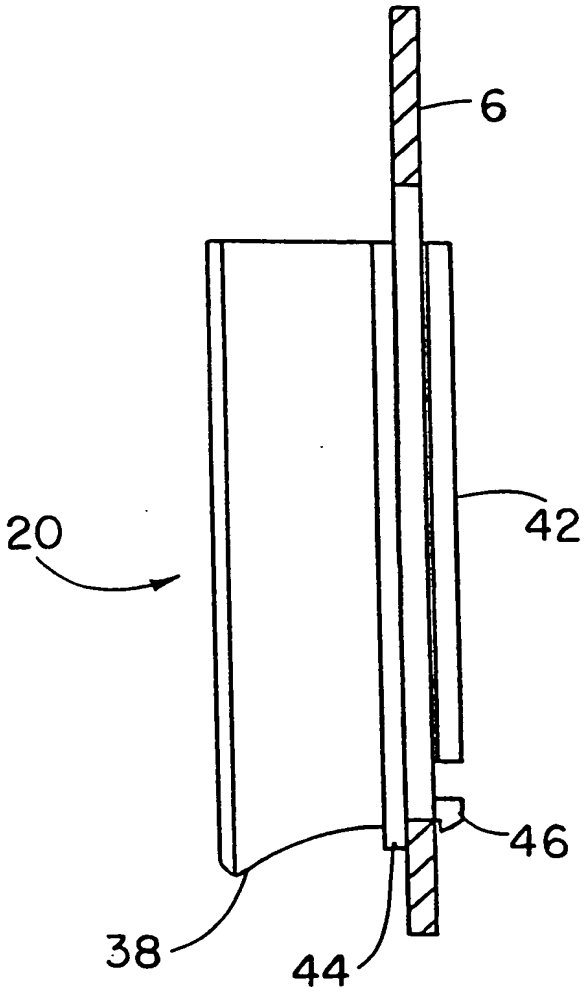

FIG. 5

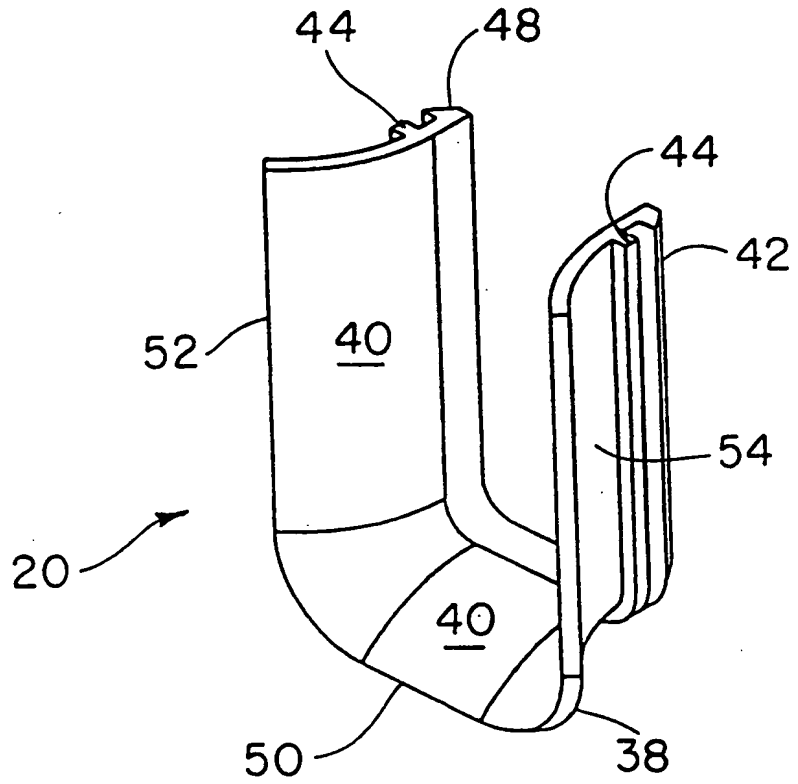

FIG. 6

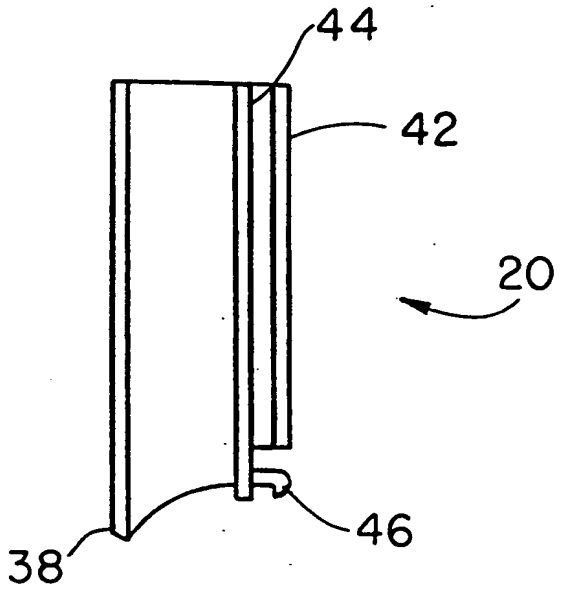

FIG. 7

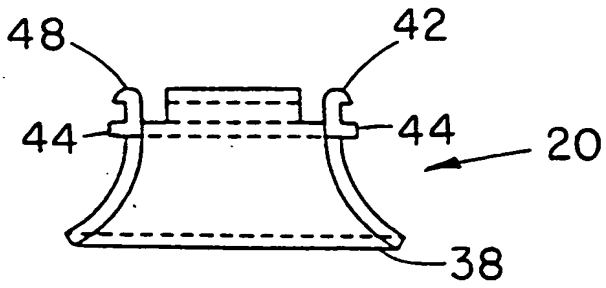

FIG. 8

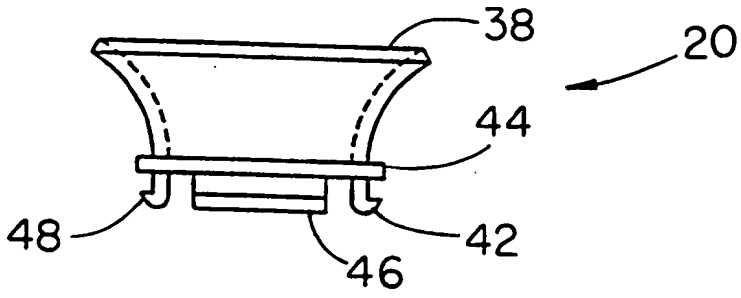

FIG. 9

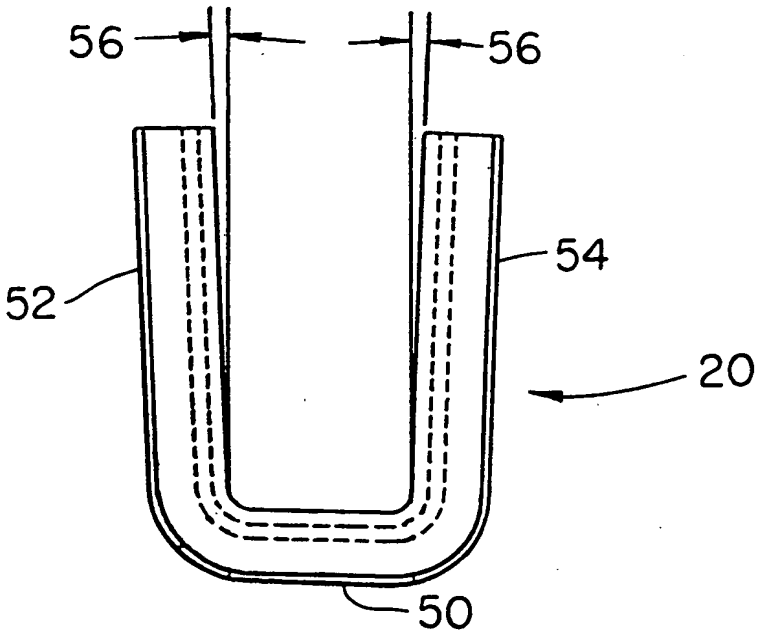

FIG. 10

INTERNATIONAL SEARCH REPORT

Inter ional Application No
PCT/US 98/03159

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G02B6/44

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G02B H02G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 100 221 A (CARNEY WILLIAM V ET AL) 31 March 1992 see abstract; figure 10	1-4,6
Y	see column 7, line 55 - column 850	8,10,11
X	DE 37 42 448 A (PHILIPS PATENTVERWALTUNG) 29 June 1989 see abstract; figure 1	1-4,6
Y	see column 1, line 28-35 see column 1, line 65 - column 3, line 5	8,10,11
Y	CH 403 904 A (THEYSOHN A.) 30 June 1966 see line 3 - page 65-90; claim 1; figures 6,7	8,11

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
17 June 1998	24/06/1998

Name and mailing address of the ISA	Authorized officer
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Form PCT/ISA/210 (second sheet) (July 1992)

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Inter ɔnal Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	"STRAIN RELIEF AND ROUTING DEVICE FOR FIBER-OPTIC CABLES" IBM TECHNICAL DISCLOSURE BULLETIN, vol. 33, no. 11, 1 April 1991, pages 289-291, XP000110401 see figures 1,2 ---	1,10
A	US 5 280 138 A (PRESTON JOHN ET AL) 18 January 1994 see abstract; figures 1,2,5,6,9-14 ---	1,10
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Information on patent family members

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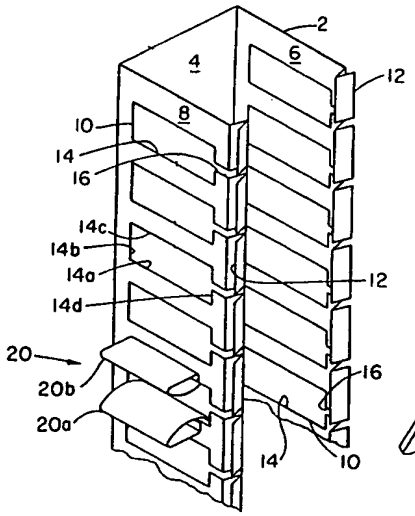

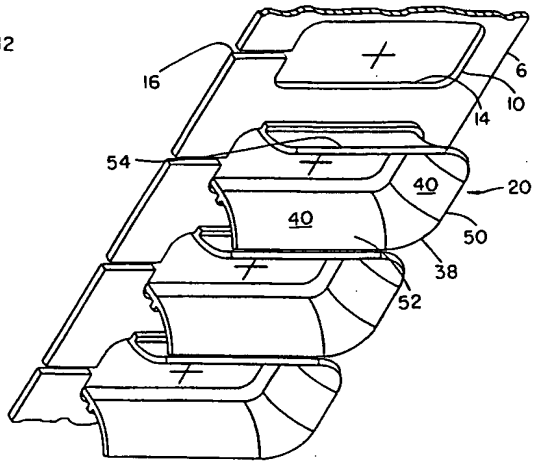

(57) Abstract

An apparatus and method for guiding, protecting and providing bend radius control for fiber optic cables is provided. Channel members having slots are used to connect fiber optic cable termination enclosures and raceway systems. In accordance with the invention, a fiber optic cable bend radius control device is snapped into each slot in the channel member. Projections on the fiber optic cable bend radius control device retain the device to the edges of the slot. The fiber optic cable bend radius control device has a gradually curved surface. Fiber optic cables extending from the enclosure to the raceway system through the slot rest on the curved surface on the fiber optic cable bend radius control device. The curved surface of the fiber optic cable bend radius control device provides a smooth, continuous surface for guiding, protecting and controlling the bend radius of fiber optic cables as they pass through the slot.

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